**Question 19**

Correct

Mark 1.00 out of 1.00

Flag question

In empirical risk minimization the predictor is:

Select one:

a. None of the above.

b. A probabilistic function.

c. A deterministic function.

**Question 20**

Correct

Mark 1.00 out of 1.00

Flag question

The regression matrix $A$ of the data $(x_i, y_i)$, $i = 1, \dots, N$, $x_i, y_i \in \mathbb{R}$, for a polynomial model of degree $k - 1$, has elements:

Select one:

a. $a_{i,j} = x_i^{j+1}, i = 1, \dots, N, j = 1, \dots, k.$

b. $a_{i,j} = x_i^{j-1}, i = 1, \dots, N, j = 1, \dots, k.$

c. $a_{i,j} = x_i^{j}, i = 1, \dots, N, j = 1, \dots, k.$

**Question 21**

**Question 17**

Correct

Mark 1.00 out of 1.00

Flag question

If $X, Y$ are random variables with values in $\mathbb{R}^D$, then:

Select one:

- a. $Cov(X,Y)$ is a matrix $D \times D$.
- b. $Cov(X,Y)$ is a scalar.
- c. $Cov(X,Y)$ is a vector $D \times 1$.

**Question 18**

Correct

Mark 1.00 out of 1.00

Flag question

Given two random variables $X$ and $Y$, Bayes Theorem implies that $p(y|x) = \frac{p(x|y)p(y)}{p(x)}$ where:

Select one:

- a. $p(x|y)$ is called posterior distribution on $y$
- b. $p(x|y)$ is called prior distribution on $x$
- c. $p(x|y)$ is called likelihood on $y$

**Question 19**

In empirical risk minimization the predictor is

Type here to search

Question 20

Correct

Mark 1.00 out of 1.00

Flag question

The regression matrix $A$ of the data $(x_i, y_i), i = 1, \ldots, N, x_i, y_i \in \mathbb{R}$, for a polynomial model of degree $k-1$, has elem

Select one:

a. $a_{ij} = x_i^{j+1}, i = 1, \ldots, N, j = 1, \ldots, k.$

b. $a_{ij} = x_i^{j-1}, i = 1, \ldots, N, j = 1, \ldots, k.$

c. $a_{ij} = x_i^{j}, i = 1, \ldots, N, j = 1, \ldots, k.$

Question 21

Correct

Mark 1.00 out of 1.00

Flag question

If $U$ is an $n \times n$ orthogonal matrix, $x \in \mathbb{R}^n$, then:

Select one:

a. None of the above.

b. $\|Ux\| > \|x\|.$

c. $\|Ux\| < \|x\|.$

d. None of the above.

**Question 15**
Correct
Mark 1.00 out of 1.00
Flag question

For a random variable $X : \Omega \to \mathcal{T}$, its variance is defined as:

Select one:

a. $Var(X) = \mathbb{E}[(X - \mathbb{E}[X])^2]$.

b. $Var(X) = \mathbb{E}[X - \mathbb{E}[X]]$.

c. $Var(X) = \mathbb{E}[X^2 - \mathbb{E}[X]^2]$.

**Question 16**
Correct
Mark 1.00 out of 1.00
Flag question

Given a discrete random variable $X : \Omega \to \mathcal{T}$, with $\mathcal{T} = \{1, 2, 3\}$ and $f_X = \{\frac{1}{6}, \frac{1}{3}, \frac{1}{2}\}$ its PMF, then:

Select one:

a. $\mathbb{E}[X] = 2$.

b. $\mathbb{E}[X] = \frac{14}{6}$.

c. $\mathbb{E}[X] = 6$.

$$\frac{1}{6} + \frac{2}{3} + \frac{3}{2} = \frac{1+4+9}{6}$$

Question 17

**Question 7**

Correct

Mark 1.00 out of 1.00

Flag question

If $A = U\Sigma V^T$ is the SVD decomposition of an $m \times n$ matrix $A$, then:

Select one:

a. None of the above

b. The rows of $V^T$ are eigenvectors of $A^T A$.

c. The columns of $U$ are eigenvectors of $A^T A$.

**Question 8**

Correct

Mark 1.00 out of 1.00

Flag question

The solution of $\min_x ||Ax - b||_2^2$ where $A$ is an $m \times n$ matrix, $m \geq n$, $rank(A) = n$, can be computed as:

Select one:

a. $AA^T x = A^T b$.

b. $A^T Ax = A^T b$.

c. $A^T Ax = b$.

**Question 9**

Correct

Mark 1.00 out of 1.00

If $f : \mathbb{R}^3 \to \mathbb{R}$, $f(x_1, x_2, x_3) = \sin x_1 - \sin x_2 \cos x_3 + x_3^2$, then $\nabla f(0, \pi, \pi)$ equals to:

Select one:

Dashboard

Question 13

Incorrect

Mark 0.00 out of 1.00

Flag question

If $f : \mathbb{R}^n \to \mathbb{R}$, $f \in C^1(\mathbb{R}^n)$, then the Gradient Descent method $x_{k+1} = x_k - \alpha_k \nabla f(x_k)$ converges to a stationary point of $f$ if:

Select one:

a. $\alpha_k \to 0$ as $k \to \infty$.

b. $\alpha_k > 0\ \forall k \in \mathbb{N}$.

c. $\alpha_k > 0$ is chosen with a backtracking procedure.

Question 14

Incorrect

Mark 0.00 out of 1.00

Flag question

If $\mathcal{A}$ is the event space and $\mathcal{T}$ is a subset of $\mathbb{R}$, then:

Select one:

a. $\forall A \in \mathcal{A}$, $X(A)$ is the probability that $X$ lies in $A$.

b. None of the above.

c. $\forall A \in \mathcal{A}$, $X(A)$ is the event "$X$ lies in $A$".

Question 15

Correct

Mark 1.00 out of 1.00

For a random variable $X : \Omega \to \mathcal{T}$, its variance is defined as:

Select one:

Dashboard

Question 5

Correct

Mark 1.00 out of 1.00

Flag question

If $V$ is a vector space, $U \subseteq V$ is a subspace, and $\Pi_U : V \to U$ is a projection. Then:

Select one:

a. $\Pi_U(x) \notin U, \forall x \in V.$

b. None of the above.

c. $\Pi_U(x) = 0, \forall x \in V.$

Question 6

Incorrect

Mark 0.00 out of 1.00

Flag question

If

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 4 \end{bmatrix}$$

then:

Select one:

a. $K_2(A) = 4.$

b. $K_2(A) = 2.$

c. $K_2(A) = \frac{1}{2}$

Type here to search

https://virtuale.unibo.it/mod/quiz/review.php?attempt=3048109&cmid=1475382#question-3084222-14

Dashboard

Question 9
Correct
Mark 1.00 out of 1.00
Flag question

If $f:\mathbb{R}^3 \to \mathbb{R}$, $f(x_1,x_2,x_3) = \sin x_1 - \sin x_2 \cos x_3 + x_3^2$, then $\nabla f(0,\pi,\pi)$ equals to:

Select one:

- a. None of the above.
- b. $(-1, 0, \pi)$.
- c. $(0, 0, 0)$.

$\nabla f =$ $\cos x_1$ ,
$\cos x_3 \cdot \cos x_2$ ,
$- \sin x_2 \sin x_3 + 2x_3$

Question 10
Correct
Mark 1.00 out of 1.00
Flag question

If $f:\mathbb{R}^2 \to \mathbb{R}$, $f(x_1,x_2) = x_1 x_2$, $g:\mathbb{R} \to \mathbb{R}^2$, $g(t) = (t, t^2)$ then, if $h(t) = f(g(t))$,

Select one:

- a. $h'(t) = 3t^2 + 1$.
- b. $h'(t) = 3t^2 - 1$.
- c. None of the above.

$\frac{\partial f(g_1,g_2)}{\partial x_1} \cdot \frac{\partial g_1}{\partial t} + \frac{\partial f(g_1,g_2)}{\partial x_2} \cdot \frac{\partial g_2}{\partial t} =$

$= t^2 \cdot 1 + t \cdot 2t = 3t^2$

Question 11
Correct
Mark 1.00 out of 1.00

If $f:\mathbb{R}^n \to \mathbb{R}$. Which of the following statements is False?

Select one:

Question 3

Incorrect

Mark 0.00 out of 1.00

Flag question

If $A \in \mathbb{R}^{n \times n}$ is symmetric and positive definite, then:

Select one:

a. None of the above.

b. $A_{i,j} \geq 0$ for all $i, j$.

c. All the eigenvalues $\lambda_i$ of $A$ are $\geq 0$.

Question 4

Incorrect

Mark 0.00 out of 1.00

Flag question

If $U$ is an $n \times n$ orthogonal matrix, then:

Select one:

a. The rows of $U$ are orthogonal vectors.

b. None of the above.

c. The rows of $U$ are orthonormal vectors.

Question 5

Correct

Mark 1.00 out

If $V$ is a vector space, $U \subseteq V$ is a subspace, and $\Pi_U : V \to U$ is a projection. Then:

Select one:

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https://virtuale.unibo.it/mod/quiz/review.php?attempt=3048109&cmid=1475382#question-3084222-14

Virtuale Dashboard

Question 1

Incorrect

Mark 0.00 out of 1.00

Flag question

$0.7 \cdot 10^{-4} = 0{,}00007$

$1{,}7892$

If $x = 0.7 \cdot 10^{-4}$ and $y = 1.7892$, which is the value of $z = x + y$ when represented in $\mathcal{F}(10, 5, -5, 5)$?

Select one:

a. None of the above.

b. $0.17892 \cdot 10^{1}$ ✗

c. $0.17899 \cdot 10^{1}$

Question 2

Incorrect

Mark 0.00 out of 1.00

Flag question

The 1-norm of a vector $x$ of size $n$ is defined as:

Select one:

a. $||x||_1 = \sum_{i=1}^{n} |x_i|$ ✗

b. None of the above.

c. $||x||_1 = \max_i |x_i|$

Question 3

Incorrect

If $A \in \mathbb{R}^{n \times n}$ is symmetric and positive definite, then:

Dashboard

**Question 11**
Correct
Mark 1.00 out of 1.00
Flag question

If $f : \mathbb{R}^n \to \mathbb{R}$. Which of the following statements is False?

Select one:

a. $x^*$ local minimum for $f \implies \nabla f(x^*) = 0$.

b. $\nabla f(x^*) = 0 \implies x^*$ stationary point for $f$.

c. $\nabla f(x^*) = 0 \implies x^*$ local minimum for $f$.

**Question 12**
Correct
Mark 1.00 out of 1.00
Flag question

Let $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = 9x_1 x_2^2 - x_1$, $\nabla f(x_1, x_2) = (9x_2^2 - 1, 18x_1 x_2)$ then which of the following is a stationary point for $f$?

Select one:

a. $(0, 0)$.

b. None of the above.

c. $(0, 3)$.

$9x_2^2 - 1 = 0 \quad x = 1/9$

$18x_1x_2 = 0 \quad x_1 = 0$

**Question 13**
Incorrect
Mark 0.00 out of 1.00

If $f : \mathbb{R}^n \to \mathbb{R}$, $f \in C^1(\mathbb{R}^n)$, then the Gradient Descent method $x_{k+1} = x_k - \alpha_k \nabla f(x_k)$ converges to a stationary point of $f$ if:

Select one:

[redacted]

Domanda 11
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^n \to \mathbb{R}$, then:

Scegli un'alternativa:

- a. $x^*$ local minimum for $f \iff \nabla f(x^*) = 0$.
- b. $\nabla f(x^*) = 0 \implies x^*$ local minimum for $f$.
- c. $x^*$ local minimum for $f \implies \nabla f(x^*) = 0$.

[redacted]

Domanda 12
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Let $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = 9x_1x_2^2 - x_1$, $\nabla f(x_1, x_2) = (9x_2^2 - 1, 18x_1x_2)$ then which of the following is a stationary point for $f$?

Scegli un'alternativa:

- a. None of the above.
- b. $(0, 0)$.
- c. $(0, 3)$.

[redacted]

Domanda 13
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

$\nabla f = (e^{x_2}, x_1 e^{x_2}$

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1 e^{x_2}$, then if the initial guess for a gradient descent iteration is $x^{(0)} = (1, 1)^T$ and $\alpha = \frac{1}{2}$, then:

$x^{(1)} = x^{(0)} - \alpha \nabla f(x^{(0)}) =$

Scegli un'alternativa:

- a. $x^{(1)} = (1 - \frac{e}{2}, 1 - \frac{e}{2})^T$. $= (1, 1) - \alpha(e, e)$
- b. $x^{(1)} = (1 + \frac{e}{2}, 1 + \frac{e}{2})^T$. $1 - \frac{e}{2}, 1 - \frac{e}{2}$
- c. $x^{(1)} = (\frac{1}{2} - \frac{e}{2}, \frac{1}{2} - \frac{e}{2})^T$.

[redacted]

Domanda 14
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$, then the posterior probability of $X$ given $Y$ is defined as:

Scegli un'alternativa:

- a. $P(X = x, Y = y)$.
- b. $P(Y = y|X)$.
- c. $P(X = x|Y)$.

[redacted]

Domanda 15
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

For a random variable $X : \Omega \to \mathcal{T}$ with $\mathbb{E}[X] = 0$, it holds:

Scegli un'alternativa:

- a. $Var(X) = \mathbb{E}[X^2]$.
- b. $Var(X) = \mathbb{E}[X]$.
- c. $Var(X) = 0$.

[redacted]

Domanda 16
Risposta

Given a discrete random variable $X : \Omega \to \mathcal{T}$, with $\mathcal{T} = \{0, 1\}$, and $f_X = \{\frac{2}{3}, \frac{1}{3}\}$, then:

**Domanda 6**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

then:

Scegli un'alternativa:

a. $K_2(A) = \frac{1}{2}$.
b. $K_2(A) = 4$.
c. $K_2(A) = 1$.

[redacted]

**Domanda 7**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

If $A \in \mathbb{R}^{m\times n}$, then:

Scegli un'alternativa:

a. It depends on $A$.
b. $A^T A$ is symmetric but not necessarly positive definite.
c. $A^T A$ is always symmetric and positive definite.

[redacted]

**Domanda 8**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

A solution of $\min_x \|Ax-b\|_2^2$ where $A$ is an $m \times n$ matrix, $m \geq n$, $rank(A) = k < n$, can be computed as:

Scegli un'alternativa:

a. $A^+ x = b$.
b. $AA^T x = A^T b$.
c. $x = A^+ b$.

[redacted]

**Domanda 9**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1^2 + x_1 x_2$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (\cos(t), \sin(t))$, then, if $h(t) = f(g(t))$:

$$\frac{\partial f(g_1,g_2)}{\partial x_1}\cdot\frac{\partial g_1}{\partial t} + \frac{\partial f(g_1,g_2)}{\partial x_2}\cdot\frac{\partial g_2}{\partial t} =$$
$$= (2\cos(t)+\sin(t))\cdot(-\sin(t)) + \cos(t)\cdot\cos(t) =$$
$$= -2\sin(t)\cos(t) - \sin^2(t) + \cos^2(t)$$

Scegli un'alternativa:

a. $h'(t) = \cos(2t) - 1$.
b. $h'(t) = 1 - \sin(2t)$.
c. $h'(t) = \cos(2t) - \sin(2t)$.

[redacted]

**Domanda 10**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1 + 2x_2^2$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (t, t^2)$ then, if $h(t) = f(g(t))$,

$1\cdot 1 + 4t^2 \cdot 2t =$

Scegli un'alternativa:

a. $h'(t) = 8t^3 + 1$.
b. $h'(t) = t^3 + t$.
c. $h'(t) = 3t^3 + 1$.

[redacted]

**Domanda 11**

Domanda **16**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given a discrete random variable $X : \Omega \to \mathcal{T}$, with $\mathcal{T} = \{0, 1\}$, and $f_X = \{\frac{2}{3}, \frac{1}{3}\}$, then:

Scegli un'alternativa:

a. $\mathbb{E}[X] = 1$.
b. $\mathbb{E}[X] = \frac{2}{3}$.
c. $\mathbb{E}[X] = \frac{1}{3}$.

[redacted]

Domanda **17**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $X, Y$ are multivariate random variables with states $x, y \in \mathbb{R}^D$, then:

Scegli un'alternativa:

a. $Cov(X, Y) = \mathbb{E}[X, Y^Y] - \mathbb{E}[X]$.
b. $Cov(X, Y) = \mathbb{E}[X, Y] + \mathbb{E}[X]\mathbb{E}[Y]$.
c. $Cov(X, Y) = Cov(Y, X)$.

[redacted]

Domanda **18**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$, Bayes Theorem implies that $p(y|x) = \frac{p(x|y)p(y)}{p(x)}$ where:

Scegli un'alternativa:

a. $p(x|y)$ is called likelihood on $y$.
b. $p(x|y)$ is called prior distribution on $x$.
c. $p(x|y)$ is called posterior distribution on $y$.

[redacted]

Domanda **19**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$ such that $p(x) = ce^{-|x|}$ and $p(y|x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(y-ax)^2}$, then the MLE reads:

Scegli un'alternativa:

a. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2 + \frac{1}{2}x^2$.
b. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2 + |x|$.
c. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2$.

[redacted]

Domanda **20**
Risposta non data
Punteggio max.: 1,00
Contrassegna domanda

Suppose a set of data $(x_i, y_i), i = 1, \dots, N$, $y_i = f(x_i) + \epsilon_i$, where $\epsilon_i \sim \mathcal{N}(0, \sigma^2)$. In linear regression, the likelihood function is:

Scegli un'alternativa:

a. $p(y|x, \theta) = \prod_{i=1}^N \mathcal{N}(x|x_i^T\theta, \sigma^2)$.
b. None of the above.
c. $p(y|x, \theta) = \prod_{i=1}^N \mathcal{N}(y|x_i^T\theta x_i, \sigma^2)$.

[redacted]

Domanda **21**
Risposta errata
Punteggio ottenuto 0,00 su 1,00

A solution of $\min_x ||Ax - b||_2^2$ where $A$ is an $m \times n$ matrix, $m \geq n$, $rank(A) = k < n$, can be computed as:

Scegli un'alternativa:

a. $x = A^+b$.

Domanda 1
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $x = 3.89167$ and $y = 0.4567$, which is the value of $z = x - y$ when represented in $\mathcal{F}(10, 5, -5, 5)$?

Scegli un'alternativa:

a. $3.434$.

b. $0.3434 \cdot 10^0$.

c. $3.4343$.

??

[redacted]

Domanda 2
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given the matrix:

$$A = \begin{bmatrix} -4 & 0 \\ -1 & -2 \end{bmatrix}$$

Compute the 2-norm and the 1-norm of $A$:

Scegli un'alternativa:

a. None of the above.

b. $||A||_2 = 4, ||A||_1 = \sqrt{5}$.

c. $||A||_2 = 6, ||A||_1 = 5$.

[redacted]

Domanda 3
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Which pairs of vectors are linearly independent?

Scegli un'alternativa:

a. $(2, 1, 0), (-3, 4, 1)$.

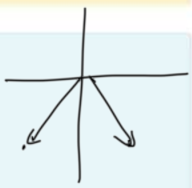
b. $(0, 1, -1), (0, \frac{1}{7}, -\frac{1}{7})$.

c. $(\frac{1}{2}, \frac{1}{3}, 2), (1, \frac{2}{3}, 4)$.

[redacted]

Domanda 4
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $x = (\overset{1}{\frac{1}{\sqrt{2}}}, -\overset{-1}{\frac{1}{\sqrt{2}}}), y = (-\overset{-1}{\frac{1}{\sqrt{2}}}, -\overset{-1}{\frac{1}{\sqrt{2}}})$, then:



Scegli un'alternativa:

a. $x$ and $y$ are orthonormal.

b. $x$ and $y$ are orthogonal.

c. $x$ and $y$ are parallel.

[redacted]

Domanda 5
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $V$ is a vector space, $U \subseteq V$ is a subspace, and $\Pi_U : V \to U$ is a projection. Then:

??

Scegli un'alternativa:

a. None of the above.

b. $\Pi_U(x)$ is the point with minimum distance to $x$ in $U$.

c. $\Pi_U(x)$ is the point with maximum distance to $x$ in $U$.

[redacted]

Domanda 6
Risposta corretta
Punteggio ottenuto 1,00

If

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \end{bmatrix}$$

Domanda 17
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
P Contrassegna domanda

If $X, Y$ are multivariate random variables, then:

Scegli un'alternativa:

a. $Cov(X, Y) = -\mathbb{E}[X]\mathbb{E}[Y] + \mathbb{E}[X, Y]$.

b. None of the above.

c. $Cov(X, Y) = \mathbb{E}[X, Y] - \mathbb{E}[X]$.

[redacted]

Domanda 18
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
P Contrassegna domanda

Given two random variables $X$ and $Y$, Bayes Theorem implies that:

Scegli un'alternativa:

$$P(x|y) = \frac{P(y|x)\,P(y)}{P(x)}$$

a. $p(x) = \frac{p(y)p(y|x)}{p(y|x)}$.

b. $p(x) = \frac{p(x|y)p(y|x)}{p(y)}$.

c. $p(y) = \frac{p(y|x)p(x)}{p(x|y)}$.

[redacted]

Domanda 19
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
P Contrassegna domanda

Given two random variables $X$ and $Y$ such that $p(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$ and $p(y|x) = ce^{-|y-ax|}$, then the MLE reads:

Scegli un'alternativa:

a. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2$.

b. $x^* = \arg\min_x |y - ax| + x^2$.

c. $x^* = \arg\min_x |y - ax|$.

[redacted]

Domanda 20
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
P Contrassegna domanda

The regression matrix $A$ of the data $(x_i, y_i), i = 1, \dots, N, x_i, y_i \in \mathbb{R}$, for a polynomial model of degree $k - 1$, has shape:

Scegli un'alternativa:

???

a. $k \times N$.

b. $N \times N$.

c. $N \times k$.

[redacted]

Domanda 21
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
P Contrassegna domanda

If $A \in \mathbb{R}^{n \times n}$ is symmetric and positive definite, then:

Scegli un'alternativa:

a. All the eigenvalues $\lambda_i$ of $A$ are $\geq 0$.

b. $A_{i,j} \geq 0$ for all $i, j$.

c. None of the above.

[redacted]

Fine revisione

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Virtuale

IB

Domanda **11**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^n \to \mathbb{R}$, $x^* \in \mathbb{R}^n$ is a strictly local minimum for $f$ if:

Scegli un'alternativa:

a. $\exists \epsilon > 0$ s.t. $f(x^*) \leq f(x), \forall x \in \mathbb{R}^n, \|x - x^*\| < \epsilon$.

b. $f(x^*) \leq f(x), \forall x \in \mathbb{R}^n$.

c. None of the above.

[redacted]

Domanda **12**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^3 \to \mathbb{R}$, $f(x_1, x_2, x_3) = 2x_2 + x_1x_3 - 3x_1x_2$, $\nabla f(x_1, x_2, x_3) = (x_3 - 3x_2, 2 - 3x_1, x_1)$ then which of the following statements is True?

$x_3 - 3x_2 = 0$ $x_1 = 0$
$2 - 3x_1 = 0$

Scegli un'alternativa:

a. The gradient of $f$ is equal to zero at multiple points.

b. The gradient of $f$ is never equal to zero.

c. $(0, 0, 0)$ is a stationary point for $f$.

[redacted]

Domanda **13**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^n \to \mathbb{R}$, $f \in C^1(\mathbb{R}^n)$, then the Gradient Descent method $x_{k+1} = x_k - \alpha_k \nabla f(x_k)$ converges to a stationary point of $f$ if:

Scegli un'alternativa:

a. $\alpha_k > 0 \; \forall k \in \mathbb{N}$.

b. $\alpha_k > 0$ is chosen with a backtracking procedure.

c. $\alpha_k \to 0$ as $k \to \infty$.

[redacted]

Domanda **14**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$, then:

Scegli un'alternativa:

a. None of the above.

b. $P(X = x|Y) \geq P(X = x)$.

c. $P(X = x|Y) \leq P(X = x)$.

[redacted]

Domanda **15**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The normal distribution $\mathcal{N}(\mu = \frac{1}{2}, \sigma^2 = 4)$ has the following PDF:

Scegli un'alternativa:

$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$

$= \frac{1}{2\sqrt{2\pi}} e^{-\frac{(x-1/2)^2}{8}}$

a. $f_X(x) = \frac{1}{\sqrt{2\pi}\exp(-\frac{x^2}{2}}$).

b. $f_X(x) = \frac{1}{2\sqrt{2\pi}\exp(-\frac{\frac{(x-\frac{1}{2})^2}{2}}{8}}$).

c. $f_X(x) = \frac{1}{\sqrt{4\pi}\exp(-\frac{\frac{(x-\frac{1}{2})^2}{2}}{8}}$).

[redacted]

Domanda **16**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two discrete random variable $X_1 : \Omega \to \mathcal{T}$, $X_2 : \Omega \to \mathcal{T}$ with $\mathcal{T} = \{0, 1\}$, and $f_{X_1} = \{\frac{1}{3}, \frac{2}{3}\}$, $f_{X_2} = \{\frac{2}{3}, \frac{1}{3}\}$ their PMF, then:

Scegli un'alternativa:

$\frac{2}{3}$

a. $\mathbb{E}[X_1] = \mathbb{E}[X_2]$.

b. $\mathbb{E}[X_1] < \mathbb{E}[X_2]$.

c. $\mathbb{E}[X_1] > \mathbb{E}[X_2]$.

[redacted]

**Domanda 6**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 4 \end{bmatrix}$$

then:

Scegli un'alternativa:

a. $rank(A) = 3.$
b. $rank(A) = 2.$
c. $rank(A) = 4.$

[redacted]

**Domanda 7**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $A = U\Sigma V^T$ is the SVD decomposition of an $m \times n$ matrix $A$, then:

Scegli un'alternativa:

a. None of the above.
b. The elements on the diagonal of $\Sigma$ are strictly positive.
c. The elements of the diagonal matrix $\Sigma$ are non-negative.

[redacted]

**Domanda 8**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

The solution of $\min_x \|Ax - b\|_2^2$ where $A$ is an $m \times n$ matrix, $m \geq n$, $rank(A) = n$, can be computed as:

Scegli un'alternativa:

a. $A^+ x = b.$
b. $x = A^+ b.$
c. $AA^T x = A^T b.$

[redacted]

**Domanda 9**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1 x_2$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (t, t^2)$, then, if $h(t) = f(g(t))$:

$t^2 \cdot 1 + t \cdot 2t$

Scegli un'alternativa:

a. $h'(t) = 3t^3.$
b. $h'(t) = t^2.$
c. $h'(t) = 3t^2.$

[redacted]

**Domanda 10**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1 + 2x_2^2$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (t, t^2)$ then, if $h(t) = f(g(t))$,

$1 \cdot 1 + 4t^2 \cdot 2t$

Scegli un'alternativa:

a. $h'(t) = t^3 + t.$
b. $h'(t) = 8t^3 + 1.$
c. $h'(t) = 3t^3 + 1.$

[redacted]

**Domanda 11**

If $f : \mathbb{R}^n \to \mathbb{R}$, $x^* \in \mathbb{R}^n$ is a strictly local minimum for $f$ if:

**Domanda 1**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $x = 0.7 \cdot 10^{-4}$ and $y = 1.7892$, which is the value of $z = x + y$ when represented in $\mathcal{F}(10, 5, -5, 5)$?

Scegli un'alternativa:

- a. None of the above.
- b. $0.17899 \cdot 10^1$.
- c. $0.17899$.

[redacted]

**Domanda 2**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $A$ is symmetric and positive definite and $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_n$ are the eigenvalues of $A$, then:

Scegli un'alternativa:

- a. $||A||_2 = \sqrt{\lambda_1}$.
- b. $||A||_2 \lambda_1$.
- c. $||A^{-1}||_2 = \lambda_n$.

$\|A\|_2 = \lambda_1$

[redacted]

**Domanda 3**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The matrix:

$1 > 0$

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 6 \end{bmatrix}$$

$6 - 6 = 0$

is:

Scegli un'alternativa:

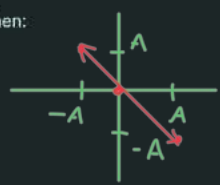
- a. Semi-negative definite.
- b. Positive definite.
- c. Semi-positive definite.

[redacted]

**Domanda 4**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $x = (\underbrace{\tfrac{1}{\sqrt{2}}}_{}, -\tfrac{1}{\sqrt{2}})$, $y = (-\tfrac{1}{\sqrt{2}}, \tfrac{1}{\sqrt{2}})$, then:

$1 \quad -1 \qquad -1 \quad 1$




Scegli un'alternativa:

- a. None of the above.
- b. $x$ and $y$ are orthonormal.
- c. $x$ and $y$ are orthogonal.

[redacted]

**Domanda 5**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $V$ is a vector space with $dim(V) = n$, $U \subseteq V$ is a subspace with $dim(U) = k$, then:

Scegli un'alternativa:

- a. $U \cup U^{\perp} = U$.
- b. $U \cap U^{\perp} = \{0\}$.
- c. $U \cap U^{\perp} = \emptyset$.

[redacted]

Domanda **11**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f:\mathbb{R}^n \to \mathbb{R}$. Which of the following statements is False?

Scegli un'alternativa:

a. $x^*$ local minimum for $f \implies \nabla f(x^*) = 0$.

b. $\nabla f(x^*) = 0 \implies x^*$ local minimum for $f$.

c. $\nabla f(x^*) = 0 \implies x^*$ stationary point for $f$.

[redacted]

Domanda **12**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f:\mathbb{R}^2 \to \mathbb{R}$, $f(x_1,x_2) = 2\sin x_1 + \sin x_1 \cos x_2$, $\nabla f(x_1,x_2) = (2\cos x_1 + \cos x_1 \cos x_2, -\sin x_1 \sin x_2)$ then which of the following is a stationary point for $f$?

$$\begin{cases} 2\cos x_1 + \cos x_1 \cos x_2 = 0 \\ \sin x_1 \sin x_2 = 0 \end{cases}$$

$x_1 = 0 \wedge x_2 = 0$

$\cancel{2}\cos x_1 = 0 \qquad x_1 = \frac{\pi}{2} + k\pi$

Scegli un'alternativa:

a. $(-\frac{\pi}{2}, 0)$.

b. None of the above.

c. $(0,0)$.

[redacted]

Domanda **13**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f:\mathbb{R}^2 \to \mathbb{R}$, $f(x_1,x_2) = x_1^2 + \cos(x_2)$, then if the initial guess for a gradient descent iteration is $x^{(0)} = (1, \frac{\pi}{2})^T$ and $\alpha > 0$, then:

$x^{(1)} = x^{(0)} - \alpha \nabla f(x^{(0)}) = (1, \frac{\pi}{2}) - \alpha(2,-1) = (1-2\alpha, \frac{\pi}{2}+\alpha)$

Scegli un'alternativa:

a. $x^{(1)} = (1+2\alpha, \frac{\pi}{2} + \frac{\pi}{2}\alpha)^T$.

b. $x^{(1)} = (1-2\alpha, \frac{\pi}{2} + \alpha)^T$.

c. $x^{(1)} = (1-2\alpha, \frac{\pi}{2} + \frac{\pi}{2}\alpha)^T$.

[redacted]

Domanda **14**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$, then:

Scegli un'alternativa:

a. $P(X = x|Y) \leq P(X = x)$.

b. $P(X = x|Y) \geq P(X = x)$.

c. None of the above.

[redacted]

Domanda **15**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

For a random variable $X : \Omega \to \mathcal{T}$, it holds:

Scegli un'alternativa:

a. $Var(X) = \mathbb{E}[X^2] - \mathbb{E}[X]^2$.

b. $Var(X) = \mathbb{E}[X]^2 - \mathbb{E}[X^2]$.

c. $Var(X) = \mathbb{E}[X^2] + \mathbb{E}[X]^2$.

[redacted]

Domanda **16**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00

Given two discrete random variable $X_1 : \Omega \to \mathcal{T}$, $X_2 : \Omega \to \mathcal{T}$ with $\mathcal{T} = \{0,1\}$, and $f_{X_1} = \{\frac{1}{3}, \frac{2}{3}\}$, $f_{X_2} = \{\frac{2}{3}, \frac{1}{3}\}$ their PMF, then:

Scegli un'alternativa:

**Domanda 16**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two discrete random variable $X_1 : \Omega \to \mathcal{T}$, $X_2 : \Omega \to \mathcal{T}$ with $\mathcal{T} = \{0, 1\}$, and $f_{X_1} = \{\frac{1}{3}, \frac{2}{3}\}$, $f_{X_2} = \{\frac{2}{3}, \frac{1}{3}\}$ their PMF, then:

Scegli un'alternativa:

a. $\mathbb{E}[X_1] > \mathbb{E}[X_2]$.
b. $\mathbb{E}[X_1] = \mathbb{E}[X_2]$.
c. $\mathbb{E}[X_1] < \mathbb{E}[X_2]$.

[redacted]

**Domanda 17**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $X, Y$ are multivariate random variables, then:

Scegli un'alternativa:

a. None of the above.
b. $Cov(X, Y) = -\mathbb{E}[X]\mathbb{E}[Y] + \mathbb{E}[X, Y]$.
c. $Cov(X, Y) = \mathbb{E}[X, Y] - \mathbb{E}[X]$.

[redacted]

**Domanda 18**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$, Bayes Theorem implies that $p(y|x) = \frac{p(x|y)p(y)}{p(x)}$ where:

Scegli un'alternativa:

a. $p(x|y)$ is called posterior distribution on $y$.
b. $p(x|y)$ is called likelihood on $y$.
c. $p(x|y)$ is called prior distribution on $x$.

[redacted]

**Domanda 19**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$ such that $p(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$ and $p(y|x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(y-ax)^2}$, then the MLE reads:

Scegli un'alternativa:

a. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2 + x^2$.
b. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2 + \frac{1}{2}x^2$.
c. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2$.

[redacted]

**Domanda 20**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Suppose a set of data $(x_i, y_i)$, $i = 1, \dots, N$, $y_i = f(x_i) + \epsilon_i$, where $\epsilon_i \sim \mathcal{N}(0, \sigma^2)$. In linear regression, the likelihood function is:

Scegli un'alternativa:

a. $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(y|\theta^T x_i^N, \sigma^2)$.
b. $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(y_i|\theta^T x_i, \sigma^2)$.
c. $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(x|\theta^T x_i, \sigma^2)$.

[redacted]

**Domanda 21**
Risposta corretta

If $f : \mathbb{R}^3 \to \mathbb{R}$, $f(x_1, x_2, x_3) = 2x_2 + x_1x_3 - 3x_1x_2$,

**Domanda 21**

Risposta corretta

Punteggio ottenuto 1,00 su 1,00

Contrassegna domanda

If $f : \mathbb{R}^3 \to \mathbb{R}$, $f(x_1, x_2, x_3) = 2x_2 + x_1 x_3 - 3x_1 x_2$, $\nabla f(x_1, x_2, x_3) = (x_3 - 3x_2, 2 - 3x_1, x_1)$ then which of the following is a stationary point for $f$?

$$\begin{cases} x_3 - 3x_2 = 0 \\ 2 - 3x_1 = 0 \\ x_1 = 0 \end{cases} \qquad \{ \; 2 = 0$$

Scegli un'alternativa:

a. $(0, 0, 0)$.

b. None of the above.

c. $(0, 2, 0)$.

[redacted]

Domanda **1**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $x = 3.89167$ and $y = 0.4567$, which is the value of $z = x - y$ when represented in $\mathcal{F}(10, 5, -5, 5)$?

Scegli un'alternativa:

a. $3.4343$.
b. $0.3434 \cdot 10^0$.
c. $3.434$.

[redacted]

Domanda **2**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

$A$ is positive definite if:

Scegli un'alternativa:

a. All its eigenvalues are $> 0$.
b. All its eigenvalues are $\geq 0$.
c. None of the above.

[redacted]

Domanda **3**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The matrix:

$$A = \begin{bmatrix} 3 & 4 \\ 4 & 9 \end{bmatrix}$$

is:

Scegli un'alternativa:

a. None of the above.
b. Symmetric and positive definite.
c. Symmetric and semi-positive definite.

[redacted]

Domanda **4**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $U$ is an $n \times n$ orthogonal matrix, $x \in \mathbb{R}^n$, then:

Scegli un'alternativa:

a. $U^T = U$.
b. $||Ux|| = ||x||$.
c. $U^2 = U$.

[redacted]

Domanda **5**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $V$ is a vector space with $dim(V) = n, U \subseteq V$ is a subspace with $dim(U) = k$, then:

Scegli un'alternativa:

a. $dim(U^\perp) = k$.
b. None of the above.
c. $dim(U^\perp) = n - k$.

**Domanda 1**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

The real number $x = 79.5\bar{4}$ in normalized scientific representation is:

Scegli un'alternativa:

a. $fl(x) = 0.7954 \cdot 10^2$.
b. None of the above.
c. $fl(x) = 0.795\bar{4} \cdot 10^2$.

[redacted]

**Domanda 2**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given the matrix:

$$A = \begin{bmatrix} -4 & 0 \\ -1 & -2 \end{bmatrix}$$

Compute the 2-norm and the 1-norm of $A$:

Scegli un'alternativa:

a. $\|A\|_2 = 6, \|A\|_1 = \sqrt{7}$.
b. None of the above.
c. $\|A\|_2 = 4, \|A\|_1 = 5$.

$\|A_1\| = |-4| + |-1| = 5$

[redacted]

**Domanda 3**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The matrix:

$$A = \begin{bmatrix} 3 & 4 \\ 4 & 9 \end{bmatrix}$$

is:

Scegli un'alternativa:

a. Symmetric and positive definite.
b. Symmetric and semi-positive definite.
c. None of the above.

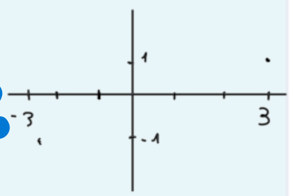
[redacted]

**Domanda 4**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $x = (3, 1), y = (-3, -1)$, then:

Scegli un'alternativa:

a. $x$ and $y$ are orthogonal.
b. $x$ and $y$ are orthonormal.
c. None of the above.




[redacted]

**Domanda 5**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $V$ is a vector space with $dim(V) = n, U \subseteq V$ is a subspace with $dim(U) = k$, then:

Scegli un'alternativa:

a. $U \cap U^{\perp} = \emptyset$.
b. $U \cap U^{\perp} = \{0\}$.
c. $U \cup U^{\perp} = U$.

[redacted]

Domanda **6**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 4 \end{bmatrix}$$

then:

Scegli un'alternativa:

- a. $rank(A) = 4.$
- b. $rank(A) = 2.$
- c. $rank(A) = 3.$

[redacted]

Domanda **7**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $A = U\Sigma V^T$ is the SVD decomposition of an $m \times n$ matrix $A$, then:

Scegli un'alternativa:

- a. The singular values $\sigma_i$ of $A$ are $\sigma_i = \sqrt{\lambda_i(A^T A)}$ where $\lambda_i(A^T A)$ are the eigenvalues of $A^T A$.
- b. None of the above
- c. The singular values $\sigma_i$ of $A$ are $\sigma_i = \lambda_i(A^T A)$ where $\lambda_i(A^T A)$ are the eigenvalues of $A^T A$.

[redacted]

Domanda **8**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The problem $\min_x \|Ax - b\|_2^2$ where $A$ is an $m \times n$ matrix, $m \geq n$, $rank(A) = k$,

Scegli un'alternativa:

- a. Has a unique solution if and only if $k < n$.
- b. Has a unique solution if and only if $k = n$.
- c. None of the above.

[redacted]

Domanda **9**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x, y) = \sqrt{x^2 - y^2}$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (e^{2t}, e^{-t})$
then, if $h(t) = f(g(t))$,

$$\frac{\partial f(g_1, g_2)}{\partial x} \cdot \frac{\partial g_1}{\partial t} = \frac{1}{\cancel{2}} \frac{\cancel{2} \cdot e^{2t}}{\sqrt{e^{4t} - e^{-2t}}} \cdot 2e^{2t}$$

$$+$$

$$\frac{\partial f(g_1, g_2)}{\partial y} \cdot \frac{\partial g_2}{\partial t} = \frac{1}{\cancel{2}} \frac{-\cancel{2} e^{-t}}{\sqrt{e^{4t} - e^{-2t}}} \cdot -e^{-t}$$

Scegli un'alternativa:

- a. $h'(t) = \frac{2e^{6t} - 1}{e^{t}\sqrt{e^{6t} - 1}}$.
- b. $h'(t) = \frac{2e^{4t} - e^{-2t}}{\sqrt{e^{4t} + e^{-2t}}}$.
- c. $h'(t) = \frac{2e^{4t} + e^{-2t}}{\sqrt{e^{4t} - e^{-2t}}}$.

$$\Rightarrow \frac{2e^{4t} + e^{-2t}}{\sqrt{e^{4t} - e^{-2t}}}$$

[redacted]

Domanda **10**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1 + 2x_2^2$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (t, t^2)$
then, if $h(t) = f(g(t))$,

Scegli un'alternativa:

$1 \cdot 1 + 4t^2 \cdot 2t$

- a. $h'(t) = t^3 + t.$
- b. $h'(t) = 3t^3 + 1.$
- c. $h'(t) = 8t^3 + 1.$

[redacted]

Domanda 11
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^n \to \mathbb{R}$, $x^* \in \mathbb{R}^n$ is a stationary point for $f$:

Scegli un'alternativa:

a. None of the above.
b. if $\nabla f(x^*) < 0$.
c. if $\nabla f(x^*) = 0$.

[redacted]

Domanda 12
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Let $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = 9x_1x_2^2 - x_1$.
$\nabla f(x_1, x_2) = (9x_2^2 - 1, 18x_1x_2)$ then which of the following statements is True?

$x_2 = \pm \frac{1}{3}$

$x_1 = 0$

Scegli un'alternativa:

a. $f$ has 2 stationary points.
b. $f$ has 1 stationary point.
c. $f$ has 0 stationary points.

[redacted]

Domanda 13
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^n \to \mathbb{R}$, $f \in C^1(\mathbb{R}^n)$, then $x^*$ is said to be a stationary point of $f$ if:

Scegli un'alternativa:

a. The Hessian of $f$ in $x^*$ is positive definite.
b. $\nabla f(x^*) = 0$.
c. $x^*$ is a minimum point of $f$.

[redacted]

Domanda 14
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $\Omega$ is the sample space, $\mathcal{A}$ is the event space and $\mathcal{T}$ is a subset of $\mathbb{R}$, a random variable $X$ is:

Scegli un'alternativa:

a. A function $X : \Omega \to \mathcal{T}$.
b. A function $X : \mathcal{A} \to \mathcal{T}$.
c. A function $X : \Omega \to \mathcal{A}$.

[redacted]

Domanda 15
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $X : \Omega \to \mathcal{T}$ is a discrete random variable with PMG $f_X : \mathcal{T} \to [0, 1]$, then:

Scegli un'alternativa:

a. $\mathbb{E}[X] = \sum_{i \in \mathcal{T}} i$.
b. $\mathbb{E}[X] = \sum_{i \in \mathcal{T}} i f_X(i)$.
c. $\mathbb{E}[X] = \sum_{i \in \mathcal{T}} f_X(i)$.

[redacted]

Domanda 16
Risposta

Given a discrete random variable $X : \Omega \to \mathcal{T}$, with $\mathcal{T} = \{1, 2, 3\}$, and $f_X = \{\frac{1}{\ }, \frac{1}{\ }, \frac{1}{\ }\}$ its PMF, then:

**Domanda 16**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given a discrete random variable $X : \Omega \to \mathcal{T}$, with $\mathcal{T} = \{1, 2, 3\}$, and $f_X = \{\frac{1}{6}, \frac{1}{3}, \frac{1}{2}\}$ its PMF, then:

Scegli un'alternativa:

$\frac{1}{6} + \frac{2}{3} + \frac{3}{2}$

$1 + 4 + 6$

- a. $\mathbb{E}[X] = 6$.
- b. $\mathbb{E}[X] = 2$.
- c. $\mathbb{E}[X] = \frac{14}{6}$.

[redacted]

**Domanda 17**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

If $X$ is a random variable with values in $\mathbb{R}^D$, $V_x$ is the variance of $X$, then:

Scegli un'alternativa:

- a. $V_x[X]$ is a vector $D \times 1$.
- b. $V_x[X]$ is a matrix $D \times D$.
- c. $V_x[X]$ is a scalar.

[redacted]

**Domanda 18**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The quantity of interest in Bayes' Theorem is:

Scegli un'alternativa:

- a. The posterior.
- b. The marginal.
- c. The likelihood.

[redacted]

**Domanda 19**
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

Given two random variables $X$ and $Y$ such that $p(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$ and $p(y|x) = ce^{-|y-ax|}$, then the MAP reads:

Scegli un'alternativa:

- a. $x^* = \arg\min_x |y - ax| + \frac{1}{2}x^2$.
- b. $x^* = \arg\min_x \frac{1}{2}(y - ax)^2$.
- c. $x^* = \arg\min_x |y - ax|$.

[redacted]

**Domanda 20**
Risposta errata
Punteggio ottenuto 0,00 su 1,00
Contrassegna domanda

Suppose a set of data $(x_i, y_i)$, $i = 1, \dots, N$, $y_i = f(x_i) + \epsilon_i$, where $\epsilon_i \sim \mathcal{N}(0, \sigma^2)$. In linear regression, the likelihood function is:

Scegli un'alternativa:

- a. None of the above.
- b. $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(x|x_i^T\theta, \sigma^2)$.
- c. $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(y|x_i^T\theta x_i, \sigma^2)$.

[redacted]

**Domanda 21**
Risposta non data
Punteggio max.: 1,00
Contrassegna domanda

If $f : \mathbb{R}^3 \to \mathbb{R}$, $f(x_1, x_2, x_3) = x_1^2 - 3x_2^2x_1 - x_3x_2$, then $\nabla f(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ equals to:

$\nabla f = 2x_1 - 3x_2^2,$
$-6x_2x_1 - x_3,$
$-x_2$

$8 \cdot \frac{1}{8} - \frac{3}{4}$
$-\frac{6}{4} - \frac{1}{2}$
$-\frac{1}{2}$

Scegli un'alternativa:

- a. $(\frac{11}{4}, -1, \frac{1}{2})$.
- b. $(\frac{11}{4}, 1, \frac{1}{2})$.
- c. $(\frac{11}{4}, \frac{1}{2}, -1)$.

Domanda 6
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

then:

Scegli un'alternativa:

- a. $rank(A) = 2.$
- b. $rank(A) = 4.$
- c. $rank(A) = 3.$

[redacted]

Domanda 7
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $A = U\Sigma V^T$ is the SVD decomposition of an $m \times n$ matrix $A$, then:

Scegli un'alternativa:

- a. The columns of $U$ are eigenvectors of $AA^T$.
- b. The rows of $V^T$ are eigenvectors of $AA^T$.
- c. None of the above

[redacted]

Domanda 8
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

The problem $\min_x ||Ax - b||_2^2$ where $A$ is an $m \times n$ matrix, $m \geq n$, $rank(A) = k$,

Scegli un'alternativa:

- a. Has infinite solutions.
- b. Has a unique solution if $k = n$.
- c. Has a unique solution for any $k$.

[redacted]

Domanda 9
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^3 \to \mathbb{R}$, $f(x_1, x_2, x_3) = \sin x_1 - \sin x_2 \cos x_3 + x_3^2$, then $\nabla f(\frac{\pi}{2}, \frac{\pi}{2}, \pi)$ equals to:

$\nabla f = \cos x_1 \to 0$,
$-\cos x_2 \cos x_3$
$+\sin x_2 \sin x_3 + 2x_3$ $\pi$ $0$

Scegli un'alternativa:

- a. $(1, 0, 2\pi)$.
- b. $(0, 0, \pi)$.
- c. $(0, 0, 2\pi)$.

[redacted]

Domanda 10
Risposta corretta
Punteggio ottenuto 1,00 su 1,00
Contrassegna domanda

If $f : \mathbb{R}^2 \to \mathbb{R}$, $f(x_1, x_2) = x_1 x_2$, $g : \mathbb{R} \to \mathbb{R}^2$, $g(t) = (t, t^2)$ then, if $h(t) = f(g(t))$,

Scegli un'alternativa:

- a. $h'(t) = t^2 + 1$.
- b. $h'(t) = 2t^2$.
- c. $h'(t) = 3t^2$. ✓

[redacted]